2005 ANNUAL STATE OF REGIONAL IOOS DEVELOPMENT and
Semi-annual Progress Report for
Development of the Alaska Ocean Observing System
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Prepared by Molly McCammon, AOOS Director
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1.0 Progress on Regional Association Development

This progress report briefly describes activities carried out in support of developing the Alaska Ocean Observing System (AOOS).

1.1 Actions taken to date

1.1.1. Governance plans

- The Governance Committee met November 23, 2004. Several private sector organizations and additional federal agencies have signed onto the AOOS effort.
- A Governance Options subcommittee has been meeting since that time to draft a new, more formal MOA to be used in the interim until a 501 (c)(3) non-profit corporation is formed. The draft of that MOA is nearly complete and will be considered by the full committee at its next meeting – likely in late May 2005.
- The State of Alaska's Ocean Policy cabinet was briefed about IOOS and AOOS plans in December 2004, but the state has not yet endorsed the IOOS concept. The state has hired an Ocean Policy Coordinator who began work March 14, 2005.

1.1.2. Stakeholder identification and engagement

- Formal and informal contacts continue to be made with potential AOOS users/stakeholders.
- A formal user/stakeholder needs survey was conducted by the Kachemak Bay Research Reserve on behalf of AOOS in preparation for the Cook Inlet Physical Oceanography Workshop held in Homer February 21-22, 2005. Stakeholders included fishermen, Anchorage Port, oil and gas industry, city and borough planners, and shipping industry.
- As a member of the National Research Council's Committee to Develop an Arctic Observing Network, I helped organize the stakeholder/user panels that provided user needs input to the committee at its Anchorage workshop February 9-10, 2005. Stakeholders included coastal engineers, oil and gas industry, Alaska Native subsistence hunters, Alaska tribes, community representatives, and commercial fishermen.
- As a member of the Alaska Sea Grant Advisory Committee, participated in their strategic planning session in November 2004, which focused on stakeholder needs, especially those of rural coastal communities.

- As a board member of both the Prince William Sound Science Center and the Cook Inlet Regional Citizens' Advisory Council, I have given presentations on AOOS and worked with their membership to identify stakeholder/user needs relevant to their missions and geographic regions. Stakeholders include commercial fishermen, local governments, tribal representatives, recreational interests, and tourism.
- Added half-day session to North Pacific Research Board Southeast Alaska Scientific Synthesis workshop held March 31, 2005. Identified commercial fishing, marine navigation, search & rescue, oil spill response, and fisheries management stakeholders and began dialogue on what a Southeast Alaska component of AOOS would look like.

1.1.3. DMAC activities

- DMAC Committee met in August 2004 and again January 27-28, 2005 to begin development of a DMAC strategy and plan for AOOS, including protocols and policies.
- DMAC Committee Terms of Reference adopted by Governance Committee in November 2004 (Appendix A).
- AOOS data manager (Rob Cermak) hired in February 2005 – based at University of Alaska Fairbanks, making use of Arctic Region Supercomputer Center and matching funds from U.S. Department of Defense. Rob is now an active participant in COTS/ONR demonstration project working groups and other IOOS DMAC activities. He is developing plans and protocols for AOOS DMAC.
- Prince William Sound Observing System – the AOOS pilot project – will go on-line this summer. Planning for that is underway.

1.1.4. Education and outreach activities

- Co-sponsored – and presented at - 2005 Alaska Marine Science Symposium, a major forum attracting more than 400 participants. Held session on ocean observing.
- Partnered with Alaska SeaLife Center in COSEE proposal.
- Contracted with Alaska SeaLife Center staff to conduct survey of education & outreach capacity in Alaska; hold a workshop in fall 2005; and develop an AOOS education, outreach & public awareness plan.
- New brochure in preparation by Alaska Sea Grant Program.
- New website in the works.

1.1.5. Business/operations plan

- Pieces of business/operations plan are under development: DMAC, education & outreach, stakeholder involvement, integration of existing assets, and plans for observing systems in Alaska's 3 major sub-regions: Arctic, Bering Sea/Aleutian Islands and Gulf of Alaska.

1.1.6. Regional Coastal Ocean Observing System Activities

- **Statewide:** A statewide implementation/operations plan is underway in conjunction with the data and analysis group at University of Alaska Fairbanks. Significant coordination and collaboration is occurring among the federal agencies working in Alaska as a result of the national IOOS initiative.
- **Arctic:** AOOS is an active participant in several planning efforts that will be used to help determine the AOOS niche in ocean observing. These efforts include the National

Research Council's Committee to Develop an Arctic Observing Network. I am a committee member and helped organize the Anchorage meeting and stakeholder/user panels. I also participated in the NOAA Climate Office workshop to prioritize Arctic activities in conjunction with the International Polar Year, as well as the National Science Foundation's workshops planning for a cabled observatory offshore of Barrow. These efforts, in coordination with the Barrow Arctic Science Consortium, will be used by the AOOS Governance Committee to help focus AOOS efforts in the Arctic.

- **Bering Sea/Aleutian Islands:** The draft Bering Sea Strategy, developed in spring 2004, is being used as the AOOS guide for BSAI priorities while it continues to be reviewed and modified.
- **Gulf of Alaska:** Most efforts in the past 6 months have focused on the Gulf of Alaska, with Prince William Sound as the pilot project. In addition, workshops have been held with stakeholders and data providers focusing on the Cook Inlet and Southeast sub-regions.

1.2 Results of the activities

- Progress is being made on all fronts: Governance, Stakeholder Engagement, DMAC, Education and Outreach, Business/Operations Plan, RCOOS activities.

1.3 Plans for the next year

1.3.1. Governance plans

- Finalize new MOA. Have signed by multiple federal, state, private, academic, tribal partners.
- Do legal work to prepare for 501 (c) (3) corporation.
- Develop approach for stakeholder/user committee (e.g., 1 statewide committee or regional committees, committee mission and terms of reference).

1.3.2. Stakeholder identification and engagement

- Continue with approach to 3 Alaska regions and sub-regions based on Large Marine Ecosystem (LME) concept.
- Give presentations to At-Sea Processors' Association Board and to North Pacific Fisheries Management Council.
- Participate in climate change/coastal erosion workshop in summer 2005.
- Work with Resource Development Council on industry forum for fall 2005.
- Hold PWS stakeholder workshop in June 2005.
- Arrange for Arctic stakeholder input in summer and fall 2005.

1.3.3. DMAC activities

- Establish data management and analysis group at UAF.
- Finalize AOOS DMAC plan.
- Provide PWS data on-line as pilot effort.
- Participate in IOOS DMAC activities.

1.3.4. Education and outreach activities

- Survey education and outreach existing activities statewide.
- Hold workshop in September with education & outreach entities to develop plan.
- Develop education, outreach & public awareness plan, as part of AOOS business/implementation plan.
- Participate in ocean observing session at national American Fisheries Society conference in Anchorage in September 2005.

1.3.5. Business/operations plan

- All of the pieces described above (Governance, DMAC, education & outreach, stakeholder engagement, and coastal observing system activities) are in progress and will be pulled together into an AOOS business/operations plan.
- The goal is to have a draft plan developed by spring 2006.

1.3.6. Regional Coastal Ocean Observing System Activities

- **Statewide:** Statewide plan to be developed by winter 2005-06 in conjunction with North Pacific Research Board Science Plan, following its review by the National Research Council.
- **Arctic:** Outreach planned for Arctic communities. Finalize Arctic Observing Network recommendations with NRC Committee.
- **Bering Sea/Aleutian Islands:** Develop joint plan with NOAA, NPRB, USGS, and NSF for BSAI activities in conjunction with IPY.
- **Gulf of Alaska:** Draft strategy for greater Gulf of Alaska will be finalized this summer. Continue with pilot efforts in PWS, including stakeholder/user and biological component workshop. Develop Cook Inlet observing system plan. Begin Southeast plan. Develop outreach activities in preparation for Kodiak/Eastern Aleutians plan.

2. Priorities for Observations from Regional Perspective

2.1 Priorities for developing the National Backbone

2.1.1. FY 06-07

- **Statewide**
  - Improved remote sensing products for entire state for sea surface height, sea ice cover, ocean color, wave height and direction, water column currents, water column salinity, and water column temperature data. Ground-truth products.
  - Integration of data from national backbone assets.
  - Increased resources devoted to comprehensive coastal and offshore mapping and charting of bathymetry and topography to reduce backlog. Make data from NOAA efforts accessible more quickly (now 3-year lag).
  - Improved integrative models – storm surge, coastal erosion, waves, circulation.
  - Updated national ice atlas and ice products: extent, thickness, etc.
  - In response to a recent request from Dr. Paul Moersdorf at NDBC, we requested deploying additional instruments to existing buoys to increase parameters measured: salinity, oxygen, currents at depth, temperature, chlorophyll, nitrate, biological variables, visibility, wave height/direction, and incoming solar radiation. Ideally, we would want T/C recorders to resolve the seasonal near-surface stratification cycle, and so would argue that instruments be placed at ~5m,

20m, & 30m, with additional instruments at 50, 100, 150, 250m if prudent. The stratification phasing is likely to change over time in various locations and is critical to the biological productivity of both the Gulf of Alaska and the Bering Sea. In order to add this instrumentation, it might be cheaper to go initially with internally recording instruments that are serviced annually. Consideration should also be given to the possibility of installing fluorometers on some of these buoys (say at the two shallowest depths).

- **Arctic**
  - Add C-MAN stations: Bering Strait, Barrow, Prudhoe, and Mackenzie River.
  - Add stream flow gauges at key sites.
  - Add NWLON stations.
  - Ground-truth remote sensing products.
  - Stabilize funding for met stations.
- **Bering Sea/Aleutians**
  - Install 5 C-MAN stations along Bering Sea coastline between Bristol Bay and Bering Strait.
  - Enhance fisheries and ecosystem information collection by expanding area covered by surveys and increasing the oceanic parameters collected.
  - Add additional NDBC buoys with additional capacity.
  - Buoy 46035 (Bering Sea) should be upgraded to complement data from a series of four buoys to be placed along the 70m isobath in the Bering Sea by NOAA PMEL to help measure warming ocean temperatures.
  - Add additional NWLON stations.
- **Gulf of Alaska**
  - Increase number of NDBC buoys, especially in Cook Inlet, Kodiak, Alaska Peninsula, and Southeast, and add additional sensor capacity. We are using the Prince William Sound Observing System as the primary pilot project for AOOS. In that region, buoy 46060 has been upgraded with AOOS funds, and 46061 and 46081 will be upgraded this summer. We would recommend that these additional buoys be upgraded with ADCPs, CTs and wave direction instruments in this order: 46082 (Cape Suckling), 46083 (SE) and 46084 (SE),

    These buoys are aligned with the dominant cyclonic current circulating the Gulf of Alaska, and the data would be very useful for monitoring transport and providing boundary conditions for numerical models. Of course, it would be important to eventually upgrade the remaining GOA buoys (46080, 46078, 46075, 46072, and 46071).

  - In the lower Cook Inlet region, upgrades to these C-MAN stations would provide important information for flow of the Alaska Coastal Current into Cook Inlet: AMAA2, FILA2, and AUGA2.
  - We would also strongly encourage NDBC to work with the Canadians to instrument buoys 46205 and 46145 in Canadian waters as these measure upstream flow into the Gulf of Alaska.
  - Increase resources devoted to bathymetric mapping and charting, especially for Cook Inlet and Southeast.

- Sustain PORTS in Cook Inlet. Study potential benefits of PORTS in Prince William Sound and Ketchikan.
- Increase number of stream gauges, and enhance them to include monitoring water quality and sediment load in real-time, particularly on large rivers.
- Add NWLON stations in Southeast.

2.1.2. FY 08-12

Continue priorities described as FY 06-07. If surface current mappers become part of national backbone (although not sure how this would work, since there is no federal agency that appears willing or able to take this on as responsibility), then add mappers in Arctic at Barrow and Prudhoe; in Bering Sea at Bering Strait, Pribilofs, Aleutian Straits, and possibly Nome; and in Gulf of Alaska in Cook Inlet, several spots in Southeast, and outer Kenai coast.

2.1.3. Changes from the previous year

Most of the priorities are the same as last year, except that they are becoming more focused as a result of additional planning and workshops. Next year's priorities will be even more focused.

2.1.4. Reasons for changes

See above.

2.2 Priorities for developing the Regional Coastal and Ocean Observing System

2.2.1. FY 06-07

- **Statewide**
  - Establish Data Management, Modeling and Analysis Group in conjunction with Arctic Region Supercomputing Center at UAF. Develop data, remote sensing, modeling, and visualization expertise for information product development.
  - Develop education and outreach plan.
  - Coordinate ship time, in order to leverage and maximize ship use.
  - Expand ROMS circulation and RAMS atmospheric models being used in PWS pilot project to statewide capacity.

- **Arctic**
  - In collaboration with National Weather Service and NOAA Climate Office, assess observing system needs (including wind and wave measurements, remote sensing products) as part of program to mitigate coastal erosion and improve navigation safety.
  - Improve forecasting of near-shore sea ice edge and motion (through expanded use of sea ice radar in real time at Barrow). Consider use at Prudhoe Bay and Nome.
  - Based on results of surface current mapper pilot project at Prudhoe Bay, consider expansion of project to other parts of Arctic.

- **Bering Sea/Aleutians**
  - Develop circulation model for Bering Sea with real time capabilities.
  - Establish and maintain a north-south array of five profiling real-time telemetry moorings along the 70m isobath with physical, chemical, biological, and met

sensors – make real time as much as possible and include measurements of entire water column where possible.
- Establish and maintain a set of moorings across the Alaska Stream south of the Aleutian Islands, including shelf break (the interface between oceanic and shelf regimes and the location of substantial trawl fishing) buoys to measure entire water column.
- Establish and maintain moorings in the Bering Strait and in key Aleutian Island passes to measure flow into and out of Bering Sea.
- Add biological measurements to existing bottom trawl surveys for U.S. shelf regions.
- Add real-time passive microphone capacity to existing moorings to monitor key indicator species such as whales.
- Assess observations needed for coastal erosion forecast and mitigation products.
- Establish and sustain ship of opportunity program for monitoring of physical, chemical and biological parameters using commercial fishing vessels, ships using the great circle route, and barge traffic.
- Collaborate with NSF and North Pacific Research Board on local and traditional knowledge observing programs.
- Improve sea ice extent and characteristics information products, as well as vessel icing forecasts.

- **Gulf of Alaska**
  - Use moorings and precipitation gauges to improve estimates of non-point (line) source coastal freshwater fluxes into the Gulf of Alaska and quantify freshwater fluxes from tidewater and coastal range glaciers. 60% of freshwater input into Alaska Coastal Current is estimated to originate in Southeast Alaska.
  - Enhance and sustain periodic lines of oceanographic surveys on the shelf and in estuaries, especially along the Seward Line. Analyze which (if any) GLOBEC transects should be continued. These can initially be done by ship, but eventually gliders could be used.
  - Add biological observing components to Prince William Sound pilot project.
  - Integrate, enhance, and sustain existing estuarine and coastal monitoring, particularly in Cook Inlet, Outer Kenai Peninsula and Prince William Sound, adding real-time capabilities.
  - Develop new monitoring capacity in Kodiak and Southeast areas.
  - Focus on improvements to search and rescue models, oil spill response models, coastal erosion models (especially for Cook Inlet), and marine sea state and vessel icing conditions.
  - Improve sea ice atlas, models, and forecasts for Cook Inlet.

2.2.2. FY 08-12

The priorities for FY 06-07 will likely continue on into FY 08-12 with several additions:

- **Arctic**
  - Add Barrow cabled observatory into observing system.
  - Expand sea ice observation program: movement and thickness measurements to improve short and long-range forecasts.

    - Implement observations needed for coastal erosion forecasts and mitigation.
- **Bering Sea/Aleutians**
    - Work with NSF and NPRB to develop coastal LTER program and include Pribilof Islands as site.
    - Expand National Weather Service ship of opportunity observation program.
- **Gulf of Alaska**
    - Develop LTER sites in GOA, possibly at Sitka Sound and Hinchinbrook Entrance
    - Analyze continuation of Continuous Plankton Recorder and ferry box projects currently funded by EVOS Trustee Council.

2.2.3. Changes from previous year

There are many changes from last year's priorities, primarily a reduction of the list to one that is more reasonable and manageable.

2.2.4. Reasons for changes

As a result of additional stakeholder input and an assessment of what is possible given funding limits, the priorities are more realistic. They will continue to be refined with additional analysis and input.

3.0 Issues, Challenges and Opportunities

Many of these challenges and issues are the same as those from last year.

- Ambiguity in what constitutes the national backbone and what is part of regional system. Are PORTS part of backbone or RCOOS? This affects how we present budget needs and information, especially to Congress, and how the regions relate to the backbone programs.
- Concern about which is the driving program – IOOS or GEOSS? Do we now say we're part of GEOSS? Is this program going to be the one that really gets funded? How do we explain these so Congress is not confused?
- There is still uncertainty about what it means to be a truly "integrated" system.
- Federal agencies must still get the message about coordination and integration. At a recent workshop on Cook Inlet physical oceanography needs, we identified four separate circulation models being developed by federal agencies for Cook Inlet without any coordination with each other. This can no longer be tolerated. The message needs to be delivered from up high on down that we can no longer afford this. It also makes it difficult to argue that new funding is needed, rather than reallocating existing funding.
- The National Federation of Regional Associations needs to get funded, organized and operational.
- Funding, funding, funding. We need to know it's there, and that the programs will be able to grow. Also, the regions need to know that there will be guaranteed funding for each region. Because of its geographic scope, Alaska will need more funding than other regions. We need MORE funding for existing backbone programs, not less.
- In Alaska, the state is still not participating in the AOOS Governance efforts. We ARE working with individuals and with more local state entities.
- Federal agencies need to be full voting partners on the governing boards of all the regional associations. Affiliate, or ex-officio membership, is not adequate.

- Opportunities for Alaska: Potential funding for a new RISA effort (NOAA's Regional Integrated Science and Assessment Program) anticipated for Alaska. Collaboration with PICES MONITOR Committee and North Pacific Ecosystem Status Report. Planning for a potential NEON effort in Alaska is underway. The International Polar Year offers some opportunities for Arctic observing activities. A major collaboration on coastal erosion among all the federal and state agencies and the University of Alaska is underway.

4.0 Recommendations for Conferences and Workshops

- How to integrate circulation and wave information into Coast Guard search and rescue models.
- Remote sensing data – opportunities; what's ending, what's beginning.
- Follow-up on coastal erosion/inundation work started at May conference.
- Role of ocean observing in ecosystem approach to fisheries management.

5.0 Recommendations for Additional Resource Needs

- Adequate funding for Ocean.US is essential for the national IOOS program.

- National DMAC funding is essential for the regions to move forward on these issues.

- Someone at ocean.us or NOAA CSC who is designated to be the liaison to all the RAs regarding DMAC issues – someone who knows what all the RAs are doing, what issues can be addressed on a national basis, what approaches and models can be used by all regions.

APPENDICES

A. DMAC Committee Terms of Reference

Appendix A. Terms of Reference

- **Definition**

The Terms of Reference of the Alaska Ocean Observing System (AOOS; http://www.aoos.org/) Data Management and Communications (DMAC) Committee establish the vision, purpose, responsibilities, governance, and rules for membership, meetings and decisions.

- **Vision**

AOOS DMAC provides seamless, effortless, end-to-end delivery of data, products and services to Alaska, other regional ocean observing associations and the U.S. national operational, integrated and sustained ocean observing system (IOOS; http://www.ocean.us).

- **Guiding Principles**

The following guiding principles address the IOOS DMAC and AOOS DMAC vision.

1.1. *Interoperability*: DMAC serves as a framework for interoperability among heterogeneous cooperating systems. The cooperating systems are free to evolve independently to address the needs of their target users. Software and standards needed to participate in DMAC are available directly to partners, or provided through commercial and non-commercial sources. DMAC is interoperable with systems outside of the marine community that manage atmospheric and terrestrial data.

1.2. *Open, easy access and discovery:* DMAC enables users from all over the globe to easily locate, access, and use the varied and distributed forms of marine data and their associated metadata and documentation in a variety of computer applications (e.g., geographic information systems and scientific analysis applications). Users are unencumbered by traditional barriers such as data formats, volumes, and distributed locations. DMAC integrates cooperating systems so that data discovery is seamless, and multiple versions are easily tracked. There is a "free market" of ocean sciences information, including officially sanctioned IOOS data sets, as well as data and products from other sources.

1.3. *Reliable, sustained, efficient operations:* DMAC provides high reliability with uninterrupted delivery of real-time data streams from measurement subsystems to operational modeling centers and users with time-critical requirements. It provides high reliability in the delivery of computer-generated forecasts, estimates of state, and delayed-mode and real-time data to end-users. DMAC requires sufficient bandwidth and adequate carrying capacity to support large exchanges of raw data and model outputs among high-volume users. DMAC facilitates techniques that reduce the need for large data transfers, such as server-side subsetting and computation, to allow users with limited bandwidth to enjoy the benefits of AOOS. Feedback mechanisms are built into the technical design of DMAC to ensure that problems are detected and rapidly addressed.

1.4. *Effective user feedback:* AOOS provides a continuous, vigorous outreach process addressing all levels of users of marine data, emphasizing the benefits of participation

in AOOS DMAC, and helping to identify and remedy difficulties encountered by those who are participating. In addition, this process identifies and addresses changing user requirements that drive the development and growth of AOOS.

1.5. *Open design and standards process:* DMAC commits to an open software design. All standards and protocol definitions are openly published so that participating organizations may create functioning DMAC components based on these specifications. The standards development process is open and inclusive, so that it fosters buy-in by all stakeholders. Existing information technology and scientific standards are used in preference to development of new solutions, wherever possible. The standards and protocols are of sufficient breadth and quality to guarantee interoperability of all observations and products. Institutions participating in AOOS ensure that the data they contribute comply with these standards and protocols.

1.6. *Preservation of data and products:* Irreplaceable observations, data products of lasting value, and associated metadata are archived for posterity in an efficient and automated manner.

- **Purpose and Objectives**

The purpose of the AOOS DMAC Committee is to facilitate the integration and communication of the disparate data and information produced by AOOS.
Objectives are:

1.7. Solicit information, define goals and formal requirements for infrastructure, and provide standards and protocols to be developed into an AOOS DMAC Implementation Plan.

1.8. Facilitate and guide DMAC aspects of a pilot study.

1.9. Broaden AOOS DMAC implementation to all geographic sub regions.

1.10. Maintain communication among data providers and stakeholders.

1.11. Promote and facilitate use of new technology for efficient data management and communication at minimal cost to participants.

1.12. Promote and facilitate use of new technology for efficient and cost-effective datamanagement and communication.

1.13. Integrate seamlessly with IOOS.

- **Responsibilities**

1.14. The AOOS DMAC Committee oversees development of the data management and communications component of AOOS and ensures its alignment with the IOOS DMAC Plan.

1.15. The AOOS DMAC Committee is responsible to AOOS for the five elements of the data communications infrastructure. These are:

- Metadata Management
- Data Discovery
- Data Transport
- On-line Browse
- Data Archive and Access

1.16. AOOS develops concrete standards and protocols for data providers, product developers and end users to support the infrastructure and insure interoperability. Although AOOS DMAC does not archive or store data products, it facilitates archival by participants. Participation in AOOS requires that agencies take responsibility to archive their data themselves or with a third-party provider.

1.17. The AOOS DMAC Committee facilitates access and installation of appropriate hardware and software to support participation.

1.18. The AOOS DMAC Committee facilitates communication between data providers, product developers and end users in order to achieve end-to-end functionality.

1.19. AOOS DMAC is not responsible for transmission of data from sensors to agencies; AOOS DMAC is not responsible for quality assurance and quality control of data and metadata.

- **Governance**

The governance of AOOS DMAC operates within the context of the AOOS governance mechanism as defined by the AOOS Governance Committee.

- **Membership**

1.20. AOOS DMAC Committee members are appointed by the AOOS Governance Committee.

1.21. The AOOS DMAC Committee consists of fifteen (15) members selected from a cross section of agencies, institutions and user groups providing information or products in the Alaska region. Eligible members are: 1) familiar with technical aspect of data management and communications, 2) actively engaged in some aspect of coastal ocean observing systems in or around Alaska or 3) principal end-users of data, products, and services from coastal ocean observing systems around Alaska. Membership may include, but is not limited to, research institutions, port or harbor authorities, Alaska

native organizations, water management districts, non-governmental organizations, local government agencies, state agencies, federal agencies, private industry, or other entities with these characteristics.

1.22. Term of membership is unlimited. A member may be removed by vote of the AOOS Governance Committee. A member may terminate his or her term by submitting a written resignation to the AOOS Governance Committee at least two months before the effective resignation date. Resigning members are encouraged to recruit replacement members.

- **Meetings and Decisions**

1.23. The AOOS DMAC Committee determines the frequency and location of its regular meetings, which occur at least annually or at the request of the AOOS Governance Committee.

1.24. Extraordinary meetings are convened by the AOOS DMAC Committee Chairperson(s) or at the request of any four AOOS DMAC Committee members.

1.25. A quorum for any AOOS DMAC Committee meeting is a simple majority, presently eight of the fifteen DMAC members.

1.26. The intention is for the AOOS DMAC Committee to act and make decisions on a consensus basis. To the extent that this is not feasible, and unless otherwise specified, the AOOS DMAC Committee will make decisions by majority vote of all members.

1.27. The AOOS DMAC Committee, in its discretion, may invite observers or other relevant parties to attend DMAC Committee meetings.

1.28. The AOOS DMAC Committee meetings are open to the public.

1.29. At any meeting of the AOOS DMAC Committee, any member, unable to attend, may designate an alternate. Each alternate exercises full powers of the member while serving in that capacity.

1.30. Reports of each AOOS DMAC Committee meeting will be prepared and distributed through the AOOS web site.